

# Study on Leaves of Plant of Family Cisalpinnea(*Caesalpinia pulcherrima*) as Non Conventional Bio Electrochemical Low Power Sources

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## ABSTRACT

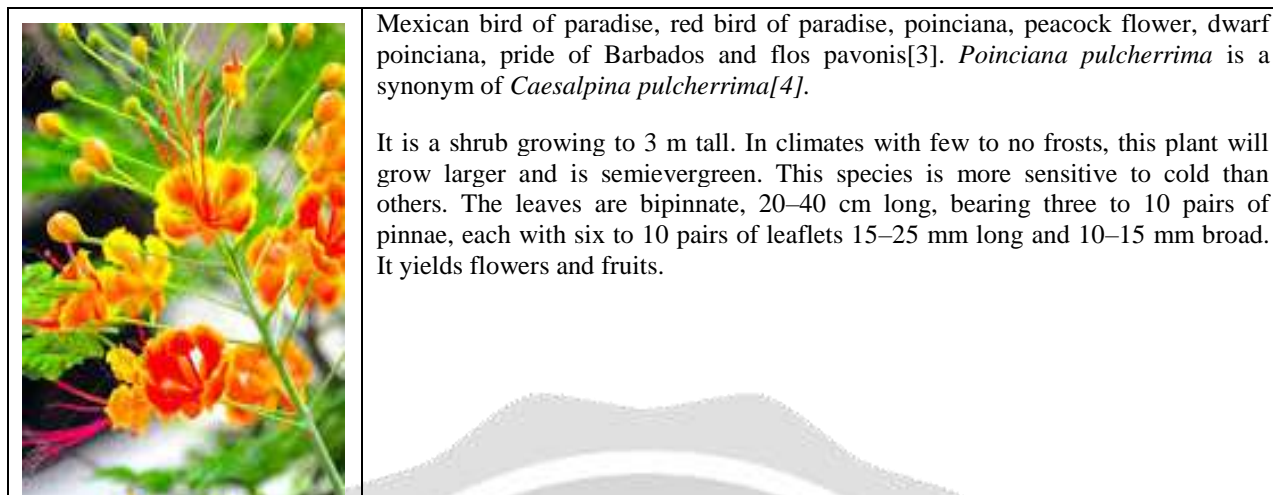
*Bio-chemical properties of plant leaves have been used to develop the nonconventional bioelectrical energy sources for micropower electronic devices and are termed as bio-emf-devices (BEDs). The peculiar characteristics details of the Bio electro devices using leaves of ornamental importance and ayurvedic medicinal plant from the family Cisalpinnea viz. Caesalpinia pulcherrima have been studied. The qualitative aspects of the leaves to develop non-conventional bio-electrochemical low power sources have been attempted. Here qualitative result indicates the possible involvement of bio-activities in the operational mechanism of bio-emf-devices.*

**Keywords:** *Nonconventional bio-electrical energy sources, Bio-chemical properties, Bio-emf-devices (BEDs), Caesalpinia pulcherrima, Low power*

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## INTRODUCTION:

*Caesalpinia pulcherrima* is a species of flowering plant in the pea family, Fabaceae, native to the tropics and subtropics of the Americas. It could be native to the West Indies[1], but its exact origin is unknown due to widespread cultivation[2]. Common names for this species include



Mexican bird of paradise, red bird of paradise, poinciana, peacock flower, dwarf poinciana, pride of Barbados and flos pavonis[3]. *Poinciana pulcherrima* is a synonym of *Caesalpinia pulcherrima*[4].

It is a shrub growing to 3 m tall. In climates with few to no frosts, this plant will grow larger and is semievergreen. This species is more sensitive to cold than others. The leaves are bipinnate, 20–40 cm long, bearing three to 10 pairs of pinnae, each with six to 10 pairs of leaflets 15–25 mm long and 10–15 mm broad. It yields flowers and fruits.

### Traditional medicine:

Maria Sibylla Merian, a 17th-century artist, encountered this plant in the Dutch colony of Surinam[5]. In her work, *Metamorphosis insectorum Surinamensium*, Merian recorded that African slaves and native Indian populations used the *flos pavonis* or *peacock flower* as an abortifacient in their practice of traditional medicine[6]. The Indians, who are not treated well by their Dutch masters, use the seeds [of this plant] to abort their children, so that their children will not become slaves like they are. The black slaves from Guinea and Angola have demanded to be well treated, threatening to refuse to have children. They told me this themselves[7].

The leaves, flower, bark, and seeds of *C. pulcherrima* were also used by American Indians in traditional medicine as abortifacients and for suicide by enslaved peoples[6].

### It's Food Value:

All the seeds of *Caesalpinia* are poisonous. However, the seeds of some species are edible before they reach maturity (e.g. immature seeds of *C. pulcherrima*) or after treatment (e.g. *C. bonduc* after roasting)[8].

### It's Ornamental value:

*C. pulcherrima* is the most widely cultivated species in the genus *Caesalpinia*. It is a striking ornamental plant, widely grown in domestic and public gardens in warm climates with mild winters, and has a beautiful inflorescence in yellow, red, and orange. Its small size and the fact that it tolerates pruning well allows it to be planted in groups to form a hedgerow; it can be also used to attract hummingbirds[9].

Literature reports shows that the emf (potential) variations with the time for Bio-electro devices with time and temperature for BEDs(bioelectro devices) made using biofluid have been studied. Results of qualitative aspects showed the involvement of BECP(bioelectro chemical properties) of plant leaves in the operation of BED. The plant parts like leaves are natural bio-system, which contain different organic and inorganic ions[10]. Regulated and Controlled ionic motion makes a bio-system different from a usual electrolytic physical system. Hence the plant parts may be defined as "bio-power conducting systems" or "bio electrolytic systems". As a good ionic conductor[11] is a pre-requisite condition for battery material. Hence, we thought of exploring the possibility of using the plant parts viz. leaves as new nonconventional material for developing low power sources for micro-electronic devices i.e the small technological object or an appliance. One of us (CJP) has published many papers on electrochemistry[12-17]. Recently, Ingle[18] have reported the study on leaves of plant of family Cisalpinnea (*Delonix regia*) as non conventional bio electrochemical low power source. Also, Jain et. al.[19] and Patil et. al.[20]

showed that the leaves can be used to generate electrical power practically. Intensive survey of the literature showed that the variation of pH has been correlated with the time as variant in case of *Hydrilla-verticiliata*[21]. Herein we present results on development and characteristics of Bio-electro devices using leaves of the ayurvedic medicinal and ornamental importance plant from family *Cisalpinnea* viz. *Caesalpinia pulcherrima*.

### EXPERIMENTAL:

A cell is constructed containing various conductors (viz. copper and zinc) is prepared using metallic plates of surface area of (2.5 x 6) cm<sup>2</sup>. A 1.2 mm thin plate of or a paper made of teflon with a central hole is affixed on one side of each of the metallic plates. The electrodes are washed, cleaned and polished before employing them to construct a unit of Bio electro devices (BED).

### RESULTS AND DISCUSSION

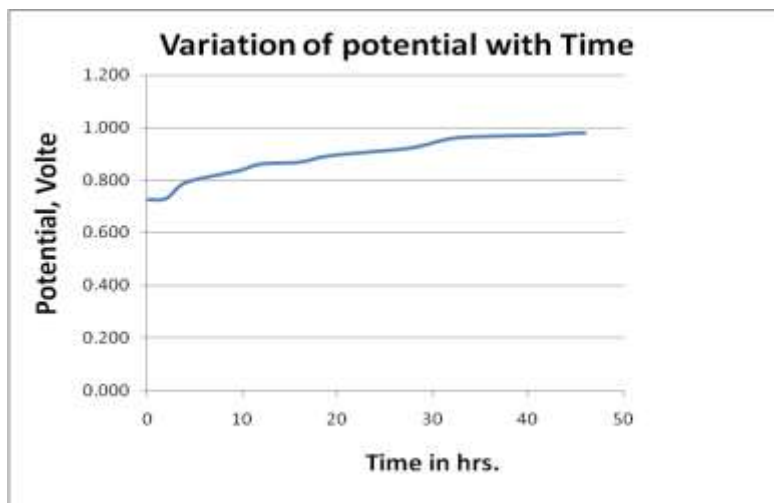
Results of the experiments done i.e variations in the potential using *Caesalpinia pulcherrima* leaves have been discussed with respect to time and temperature, under open circuit conditions.

**Variation of Potential with Time:** The results of Bio electro devices under open circuit condition for potential variations are shown in **Fig. 1**.

**Table-1:** Results of bio electro-device for voltage and time for biofluids of *Caesalpinia pulcherrima* from family *Cisalpinnea* (under open circuit condition)

Sr. No.	Time, in hrs.	Voltage, in V
1	0	0.726
2	2	0.730
3	4	0.790
4	8	0.824
5	10	0.840
6	12	0.862
7	16	0.869
8	18	0.886
9	20	0.897
10	24	0.910
11	28	0.925
12	32	0.960
13	36	0.968
14	40	0.971
15	42	0.972
16	44	0.979
17	46	0.981

The graphical representation of the values were shown in **Fig. 2**.



**Fig. 1:** Variation of potential with time period of bio electro devices for *Caesalpinia pulcherrima* (under open circuit condition).

The Bio electro devices gave initial value of as 0.850 V, at temperature 32°C, which changed with time and did not follow any definite trend, over all it increases very slowly. It have been noted that its value is even larger than the initial value. Therefore, it is difficult here to appeal the electrochemical principles[22] to evaluate value theoretically. The variations are possibly bio-originated.

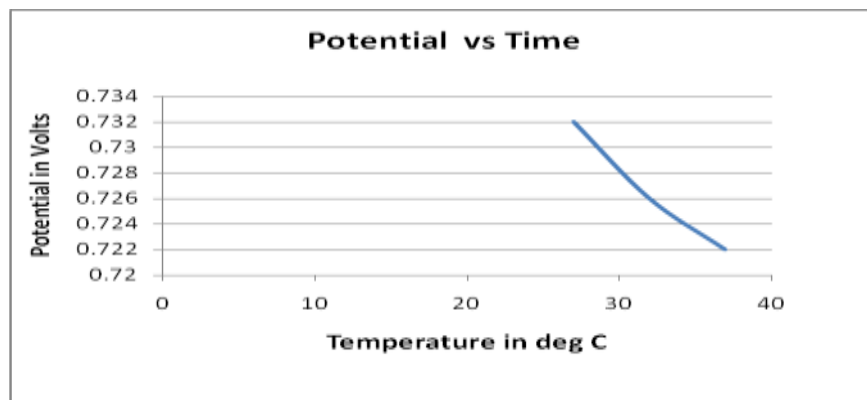
The phytomarkers (phytochemicals) may be responsible for the observed process of variations of potential. These, observations thus indicate about an involvement of a large number of energy producing bioelectro chemical reactions in the operation of Bio electro devices. The bioelectro potential (BEP) of plants has recently attracted attention[19, 23].

**Variation of Potential with Temperature:** The results of bio electro devices under open circuit condition for potential showed initial value 0.726 at 32°C(the values at different temperature are indicated in Table-2) and shown variation with temperature 27, 32 and 37°C as 0.732, 0.726 and 0.722 V in case of *Caesalpinia pulcherrima*. The graphical representation of the variation of potential with time in hours for biofluids is depicted in **Fig. 2**.

**Table-2:** Results showing potential at different temperature for biofluids of *Caesalpinia pulcherrima*.

Sr. No.	Temperature in °C	Potential in V
1	27	0.732
2	32	0.726
3	37	0.722

The graphical representation of the variation of potential with rise in temperature is depicted in **Fig. 2**.



**Fig. 2:** Variation of potential(volts) with temperature for *Caesalpinia pulcherrima* (under open circuit condition).

The observed results are in con occurrence with that observed by C. J. Patil et. al.[20, 24-25], Manisha Patil et. al.[20] respectively for Leaves of Plant of Families Morigaceae and Polygonaceae and Leaves of Vinca rosea. Also, similar results were reported by Ingale[18].

## CONCLUSION:

Though the operational mechanism of Bio electro devices is yet to be investigated clearly, its prospective use to energizing micro-electronic circuits seems very exciting and of much practical value. We have been successful in operating various small electronic devices. Further experiments on the homo electrode pair Bio electro devices to establish the role of bioactivity in the operation of Bio electro devices are underway in our laboratory.

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